63c Combined Leis/Surface Chemical Probe Study of Topmost Surface Chemistry of Multicomponent Bulk Mo-V-O Catalysts for Propane (Amm)Oxidation

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The current abundance and low cost of propane has generated much recent interest in its oxidative catalytic conversion to acrylic acid and acrylonitrile in petroleum and petrochemical industries. The recently discovered multicomponent V-Mo-M-O (M= combinations of Nb, Te, Sb, etc.) catalytic system appears to be the most active and selective for this transformation. However, the current fundamental understanding of these catalysts is rather limited due to the lack of studies that directly examined the surface chemistry of this catalytic system. This study reports the hydrothermal synthesis, physicochemical characterization, catalytic behavior and topmost surface chemistry of two model bulk (Mo-V-O and Mo-V-Te-Nb-O) catalysts with orthorhombic M1 phase structure. These two model catalysts displayed dramatically different performance in propane oxidation to acrylic acid. The Mo-V-O catalyst was essentially unselective in propane oxidation to acrylic acid (~3 mol. % selectivity at ~9% propane conversion at 400^{o}C), while the Mo-V-Te-Nb-O catalyst was significantly more selective (~49 mol. % selectivity at ~18% propane conversion at 380^{o}C). The insights into the topmost surface chemistry of these model catalysts came from Low Energy Ion Scattering (LEIS) study. We report and discuss the surface composition of the Mo-V-O and Mo-V-Te-Nb-O catalysts (i) after kinetic study, (ii) after atomic oxygen treatment to remove the surface contamination; (iii) at room temperature and 400^{o}C; (iv) during methanol and allyl alcohol chemisorption and step-wise thermal desorption at r.t.- 400^{o}C.